

**United  
Technologies**

Model Based Design Approach  
for  
Complex System Design

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# UNITED TECHNOLOGIES CORPORATION



# UTC CLIMATE CONTROLS & SECURITY

UTC CLIMATE, CONTROLS & SECURITY



UTC Climate, Controls & Security's fire safety, security, building automation, heating, ventilation, air conditioning and refrigeration systems and services promote safer, smarter and sustainable buildings.



## Key Facts

**56,475**  
Employees

Carrier's refrigerated containers carry more than \$6 billion worth of goods every day.

**\$16.9B**  
Net sales

Since 2002, Kidde has donated more than 1 million smoke and carbon monoxide alarms to fire departments.

**\$3.1B\***  
Adjusted operating profit

\*Adjusted operating profit is a non-GAAP financial measure. For additional information regarding the use of this measure, the corresponding amount prepared in accordance with generally accepted accounting principles (GAAP) and a reconciliation of the differences between the non-GAAP and GAAP measure, please refer to [page 71 in the UTC 2016 Annual Report](#).

# UTC OTIS



 **Otis**  
A United Technologies Company

**Otis elevators, escalators and moving walkways keep people moving. As the world's leading installer and maintainer, we are committed to safety, performance and service.**

**67,396**  
Employees

**\$11.9B**  
Net sales

**\$2.2B\***  
Adjusted operating profit

**Key Facts**

We introduced the world's first safety elevator to the market in 1853.

Our companies maintain 1.9 million elevators, escalators and moving walkways worldwide.

Otis is providing 670 elevators and escalators to the Hyderabad Metro in India, the largest elevator contract in the country's history.

\*Adjusted operating profit is a non-GAAP financial measure. For additional information regarding the use of this measure, the corresponding amount prepared in accordance with generally accepted accounting principles (GAAP) and a reconciliation of the differences between the non-GAAP and GAAP measure, please refer to [page 71 in the UTC 2018 Annual Report](#).

# UTC CLIMATE CONTROLS & SECURITY BRANDS

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# HYDERABAD RESEARCH & DESIGN CENTER

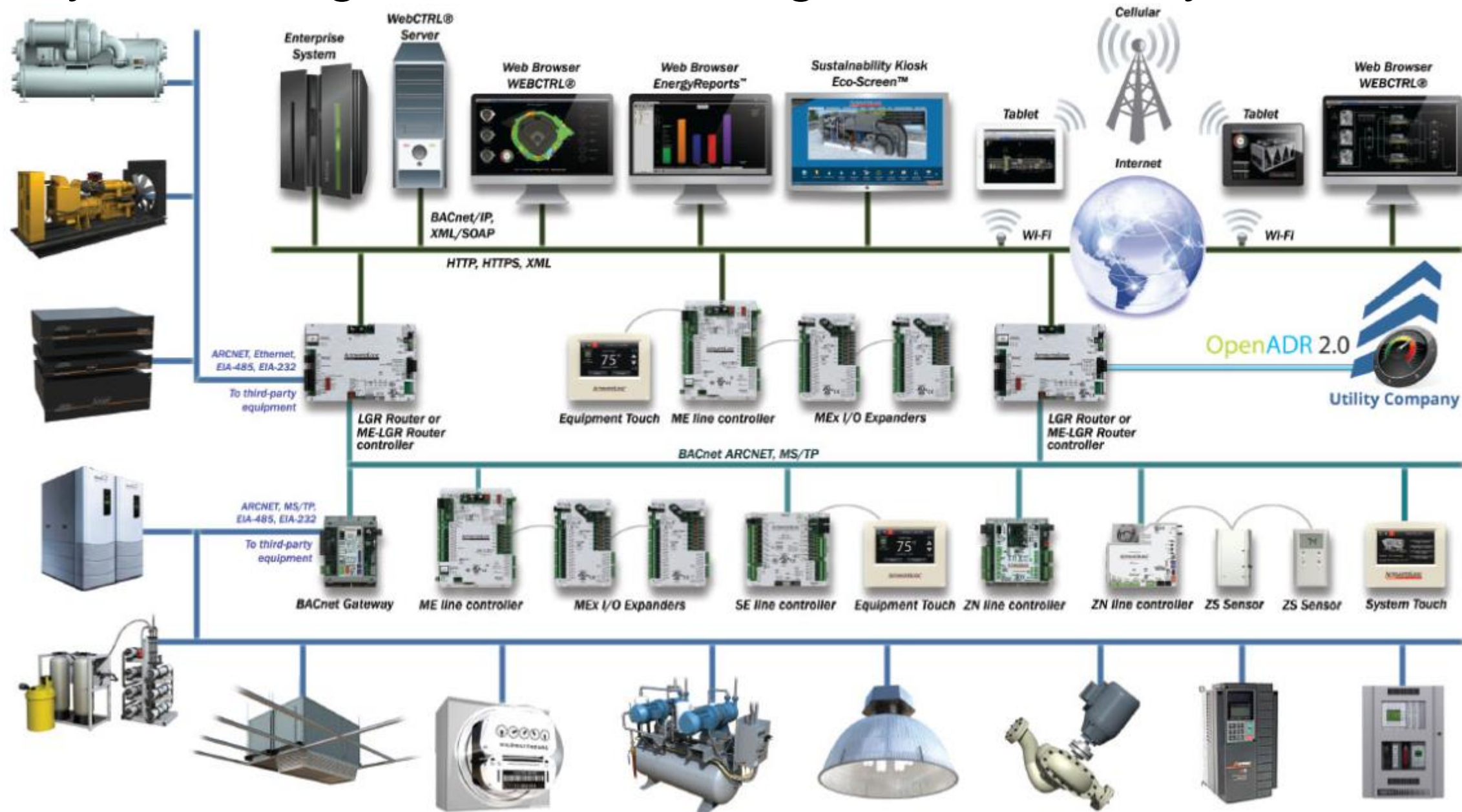
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United Technologies  
Announces Opening of  
New Hyderabad  
Research & Design  
Center →



# COMPLEX SYSTEM

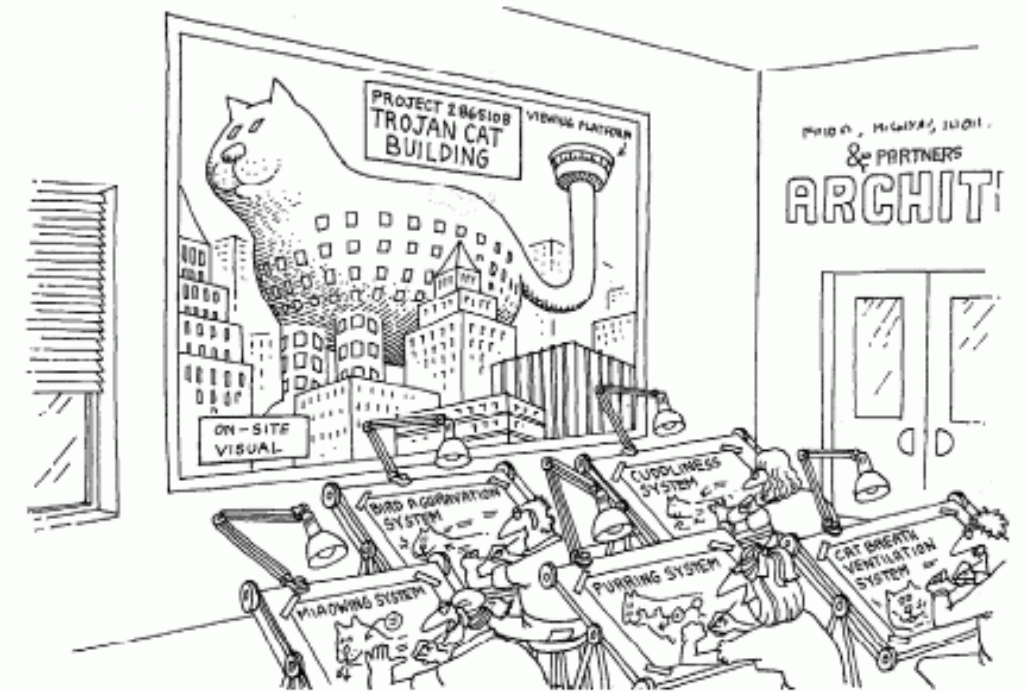
## Sample System Diagram for a Building Automation System



# COMPLEX SYSTEM DESIGN

## Main Challenges

- ❖ Complex interfaces
- ❖ Prolonged Development time
- ❖ Late Identification of Quality issues
- ❖ Dynamic Behavior Simulation
- ❖ Lower Reliability
- ❖ Convoluted Impact of changes during iterations
- ❖ Increased data matrices for development, testing
- ❖ Changes in regulations, legal restrictions



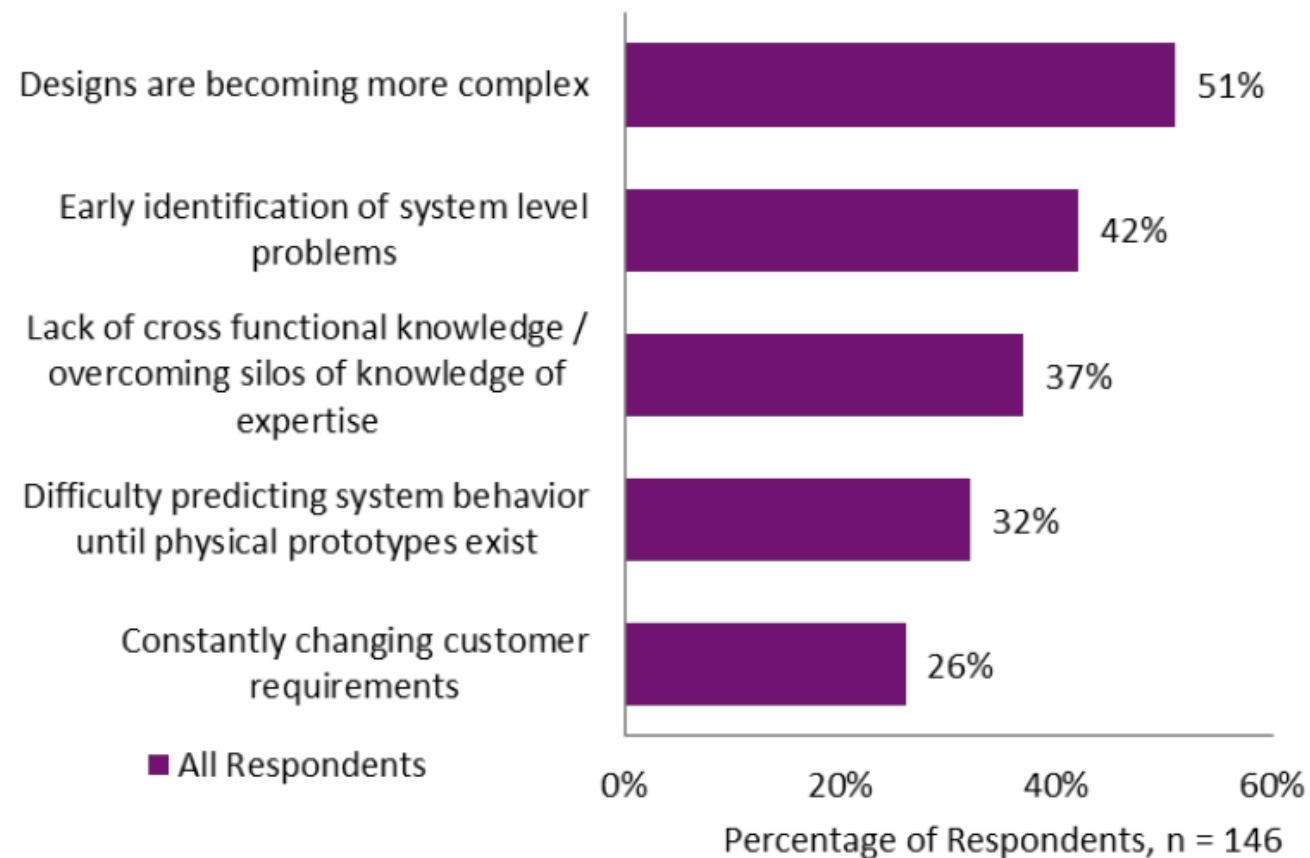
The architecture of a complex system is a function of its components as well as the hierarchic relationships among these components.

Reference - <http://www.webreference.com/programming/java/complexity/3.html>

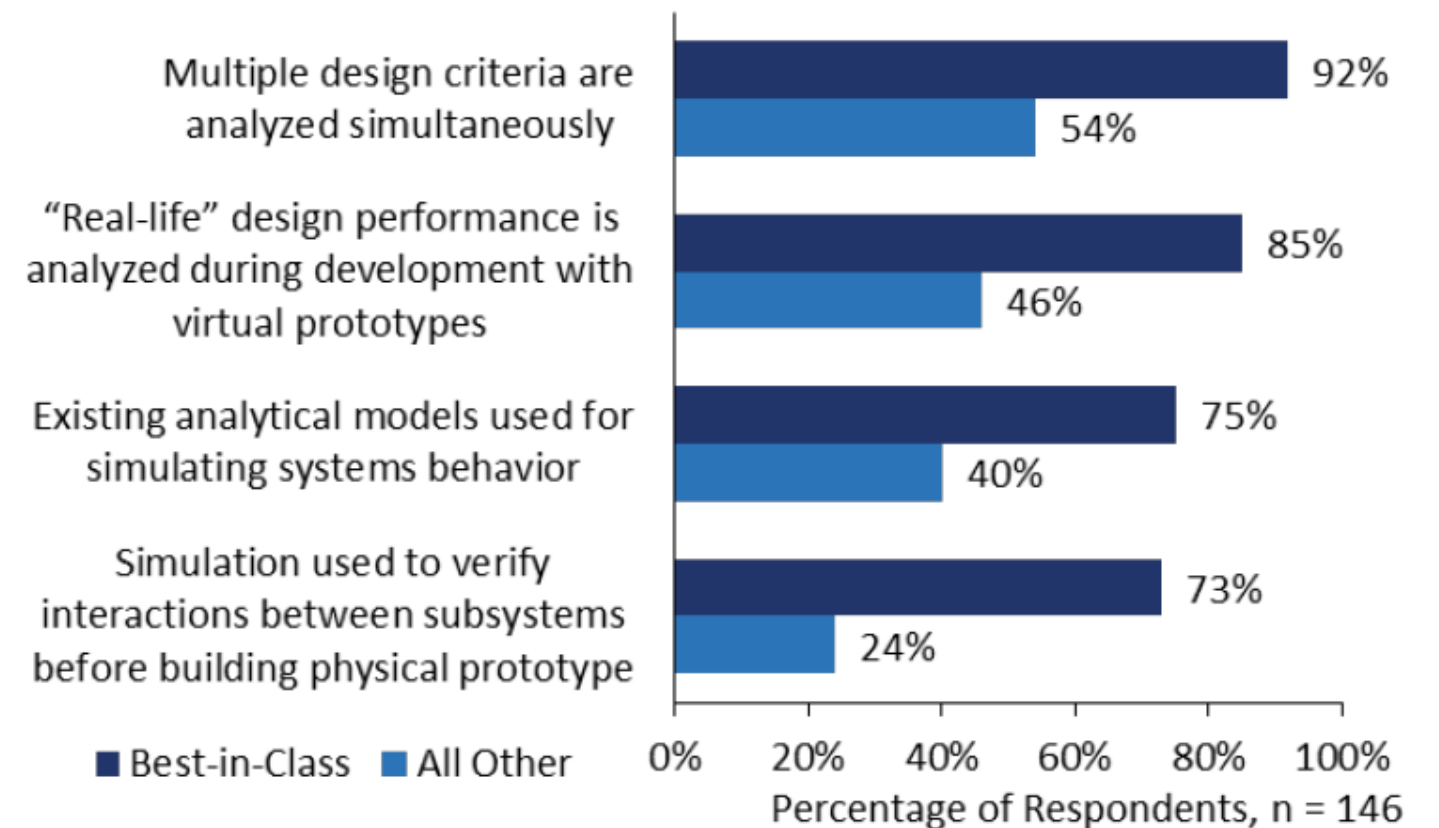


# COMPLEX SYSTEM DESIGN

## Main Challenges



## Comparison of Best in Class and Others in using Simulation throughout the Design Phase

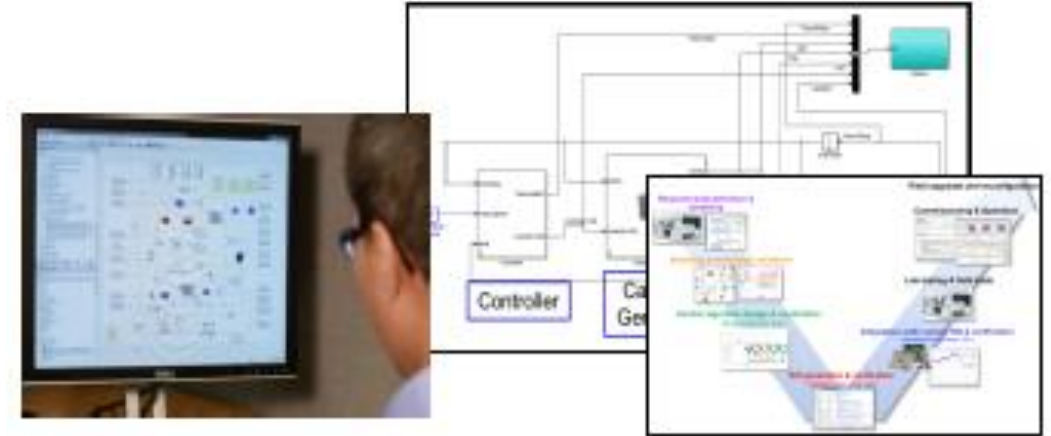


# MODEL BASED DESIGN

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## Benefits

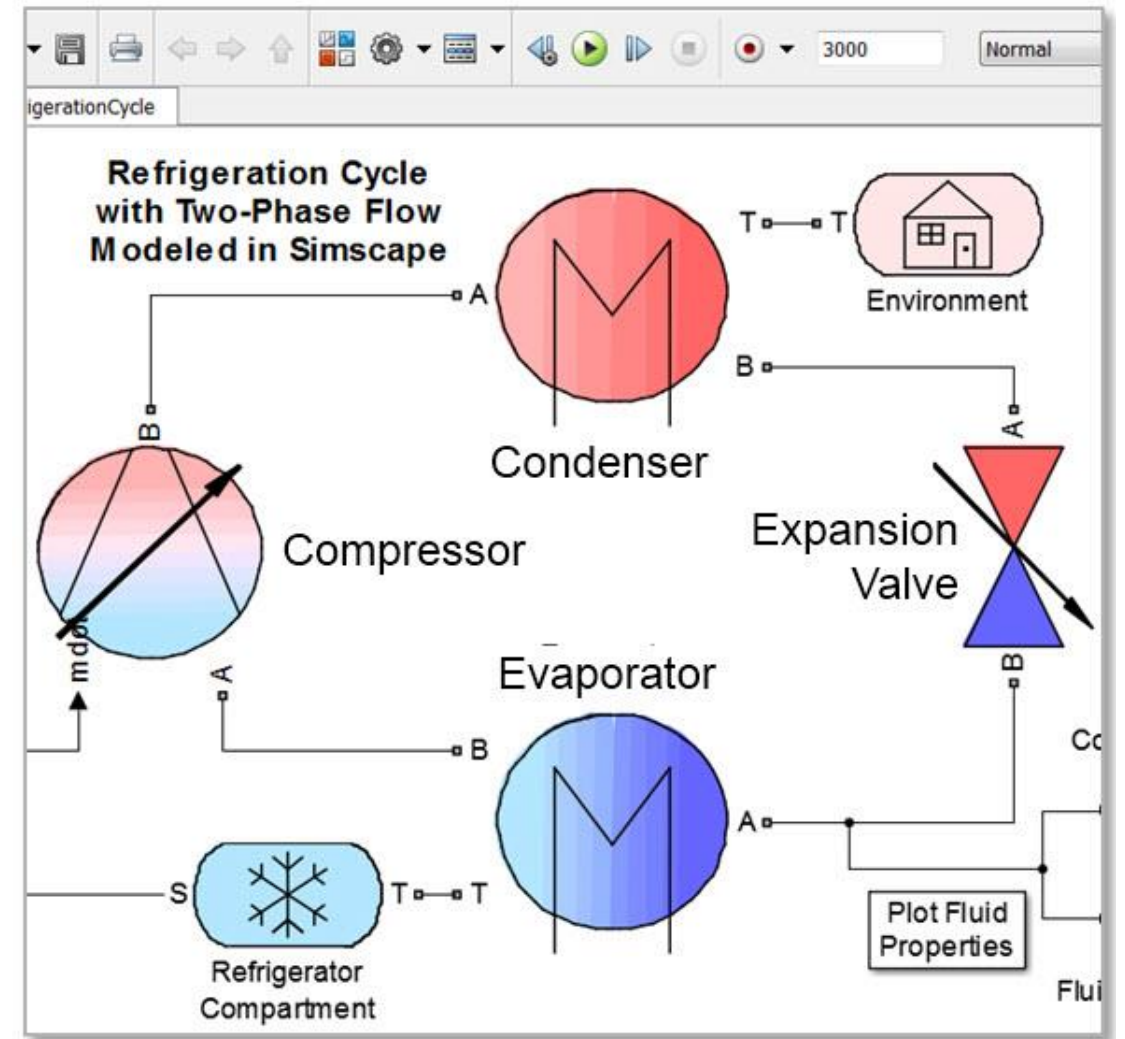
- ✓ Use a common design environment
- ✓ Link designs directly to requirements
- ✓ Integrate testing with design
- ✓ Refine algorithms through multi-domain simulation
- ✓ Automatically generate embedded software code and documentation
- ✓ Develop and reuse test suites
- ✓ Accelerate time to market



# MODEL BASED DESIGN

## Benefits

Entire Refrigeration Cycle can be simulated using tools and dynamic behavior can be virtualized to enhance product development



***Changing customer expectations,***

***faster time to market and***

***increased regulations ...***

***Model Based Design is the way forward!***



**United  
Technologies**

Hyderabad Research & Design Center

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Thank you!